Nasal Bridling for the Improved Delivery of Enteral Nutrition

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Abstract

Problem: Critically ill patients are at an increased risk for malnutrition and its adverse effects. Chart audits were conducted on a 22-bed, medical cardiovascular intensive care unit revealed that out of 44 included patients, 37 did not receive at least 80% of their recommended nutrition. After a root cause analysis was conducted, unintentional feeding tube dislodgement was identified as a major contributor to interruptions in tube feed delivery. **Purpose:** The purpose of this project was to increase the delivery of enteral nutrition to patients in the intensive care unit by implementing nasal bridles as the standard practice for securing nasogastric tubes. **Methods:** Implementation of nasal bridles as the standard securement of nasogastric tubes was supported through the integration of high-quality staff engagement through hands-on training opportunities, competency development, environment optimization, and clinical advancement incentive opportunities. All patients with nasogastric tubes and enteral nutrition orders for at least 24 hours were included in this quality improvement project. Every 24 hours, patient charts were audited for method of tube securement, and total enteral nutrition delivered compared dietician recommendations. **Results:** Baseline data collection indicated an average delivery of 44% of enteral nutrition requirements. During the last month of project implementation, the documented delivery of enteral nutrition improved to over 90%. Patients with nasogastric tubes secured with bridles, on average, received more enteral nutrition (88.5%) than those secured by adhesive or tape (70.8%). Lastly, 30 nasogastric tubes secured by adhesive or tape were dislodged compared to zero dislodged tubes secured by bridle over the course of this project. **Conclusions:** Nasal bridles are an effective method to reduce inadvertent tube dislodgement and increase the delivery of enteral nutrition in this medical cardiovascular intensive care unit.

Keywords: Enteral, nasogastric, feeding, nutrition, tube, nasal, bridle

Nasal Bridling for the Improved Delivery of Enteral Nutrition

Patients who are critically ill are at an increased risk for malnutrition and its adverse effects. They are often in a state of inflammation, increased stress, catabolism, and have increased caloric and protein needs. These same patients are also much less likely to receive the nutrition that they need and are dependent on enteral support (Ojo et al., 2022). While recent guidelines support the early initiation of enteral nutrition in these patients, many barriers persist and disrupt its adequate delivery (Compher et al., 2021) (Heyland et al., 2015) (Lee et al., 2018). In fact, nearly 75% of all patients in all critical care areas fail to receive at least 80% of their estimated nutritional needs (Krebs et al., 2018). Malnutrition is an independent risk factor for prolonged mechanical ventilation, prolonged intensive care and hospital length of stay, and the prevalence of hospital acquired infections and pressure injuries (Sheckter et al., 2018).

Chart audits were conducted on a 22-bed, medical cardiovascular intensive care unit at a level I trauma center, from November 7th, 2021, to November 14th, 2021. During these audits, 44 patients were identified for inclusion. Of those 44 patients, 37 did not receive at least 80% of their nutritional goals. Only four received 100% of their determined nutritional needs. Moreover, hospital reports showed increased incidence of hospital acquired pressure injury and infection in all critical care areas over the prior year. A root cause analysis was conducted to determine key contributors to the inadequate delivery of enteral nutrition and the unintentional loss of functional feeding tubes was identified as a significant source of nutrition interruption. Standard securement measures involved the use of adhesive tape and were prone to failure. This resulted in the loss of feeding access. Resuming nutrition required tube replacement and confirmatory chest radiograph with interpretation by a licensed provider. This often resulted in several hours of missed tube feeding, possible patient trauma, increased radiographic exposure, increased nurse

and provider workload and increased hospital expenditure.

Purpose Statement

The purpose of this quality improvement project was to increase the delivery of enteral nutrition to critically ill patients in the medical cardiovascular intensive care unit, by implementing feeding tube bridles as the standard of practice for securement of nasogastric tubes.

Available Knowledge

This project aimed to decrease the incidence of feeding tube dislodgement by implementing nasal bridles as the standard securement method for all nasogastric feeding tubes. Nasal bridling utilized the patient's own vomer bone as an anchoring point for gentle tubing to form a loop around. This loop then attached to and secured an established nasal feeding tube (Li et al., 2018). A review of current literature, disclosed in Appendix B in Tables 1 and 2, yielded considerable evidence to support this intervention. Three systematic reviews found that nasal bridles significantly reduced feeding tube loss when compared to traditional tapes and adhesives. Furthermore, they established that the delivery of enteral nutrition significantly increases with bridle use. (Bechtold et al., 2015) (Brugnolli et al., 2014) (Lynch et al., 2018). Another study found a significant reduction in the hours of missed tube feeding when bridles were used to secure feeding tubes. (Li et al., 2018). Lastly, many researchers noted significant cost reductions associated with bridle securement secondary to decreased use of confirmatory radiographs for replacing feeding tubes. (Allan et al., 2019) (Atkar et al., 2021) (Lynch et al., 2018).

Process measures for this intervention included compliance to using bridling for securing all newly placed feeding tubes. Compliance was assessed via documentation in the electronic medical record and in-person confirmation through rounding on the unit. Outcome measures

tracked include incidence of feeding tube dislodgement and delivered percentage of enteral nutrition goal. Balancing measures collected include the incidence of any trauma or injury related to the use of bridle securement.

Rationale

The Knowledge-to-Action Framework was key to project operationalization. This framework was selected for its focus on contextualizing research knowledge to the project site, and tailoring interventions to target site-specific barriers to knowledge use (Graham et al., 2006). This framework starts with the recognition of a problem and is followed by identifying a process gap. In this case, the problem identified was the reduced delivery of enteral nutrition while the process gap was the use of adhesive tape for feeding tube securement. This gap was addressed by updating the practice standards to include nasal bridle securement of all nasoenteral feeding tubes. The implementation phase was monitored closely in order to tailor interventions and tactics to project and site needs. See Figure 2 for the full adaptation plan of the Knowledge to Action Framework.

Methods

Context

The DNP project "Nasogastric Bridling for the Improved Delivery of Enteral Nutrition" was conducted on a 22-bed medical cardiovascular intensive care unit at a large tertiary care academic center. Prior to project implementation, the process for the initiation of enteral nutrition started with the provider placing an order for nasogastric tube placement and continuous enteral feeds. Standard practice at that time was to place the nasogastric tube, secure it with adhesive tape, and confirm placement by chest radiograph. After tube placement was confirmed, tube feeding began at the prescribed rate. Before implementation, as many as 50% of

patients on enteral nutrition in the CVICU ended up dislodging their feeding tubes. Dislodgement required immediate cessation of feed delivery, resulting in significant delays in nutrition administration. The goal of this project was to reduce the rate of feeding tube dislodgement and subsequent nutrition loss by replacing adhesive securement with bridle securement.

Intervention

A variety of implementation strategies and tactics were utilized to facilitate a successful practice change. In addition to weekly education sessions, existing hospital and unit structures were optimized for project implementation. This included utilization of the "Clinical Advancement Program" (CAP) where bedside staff were incentivized to take on the role of a "Champion." Champions functioned as additional educators and peer-trainers on nasal bridle placement. Champions covered each day of the week and a variety of shift times to ensure all nurses on the unit were reached. A "nasal bridling practice box" was created to address staff needs for skill development and re-enforced project objectives. This box included eight anatomically correct models of noses made from foam clay, a total of four nasal bridles, sampling all available sizes, and instructional fliers with QR codes linking to video demonstration of placement technique. This box was then utilized by champions and the project-lead to advertise the project, provide rounding "workshops," and perform skills check offs. Lastly, during project implementation, the box remained in the common room as an available resource to all staff. Several nurses reported practicing on the clay models immediately prior to placing and bridling a patient's nasogastric tube. This additional resource bolstered staff confidence and preparation, ultimately facilitating increased compliance to the intervention.

Measures

Project measures tracked include feeding tube securement method, the incidence of feeding tube dislodgement and replacement, and percentage of enteral nutrition delivered. Feeding tube securement was tracked to determine compliance to the intervention. While this was collected from the electronic medical record, in person rounding by the project lead and champions validated the accuracy of this extrapolated information. Next, unintentional feeding tube dislodgement was tracked via electronic medical record documentation. Unintentional feeding tube dislodgement was defined as any time a nasoenteral feeding tube was displaced from a functional location. For example, if a tube was dislodged by one centimeter and was still considered functional it was not counted as a dislodgement. However, if that tube was removed by thirty centimeters and needed to be replaced, then it was recorded as a dislodgement. Feeding tube securement method and incidence of tube dislodgement were both process measures for the improved delivery of enteral nutrition in this project.

Lastly, the primary outcome measure tracked was the percentage of nutrition delivered to all patients in the medical CVICU. This percentage is a calculated value. For each patient, the total volume of enteral nutrition delivered was divided by the total volume of enteral nutrition recommended by a registered dietician for that specific patient. This accounted for the varying nutritional needs across the patient population.

Ethical Considerations

While the intention of this project is to improve patient outcomes, possible adverse effects related to the intervention must be considered. In the systemic review by Lynch et al., researchers explored whether nasal bridles increased the risk of iatrogenic pressure injury due the bridle's close proximity to fragile mucosa. While there were a few instances of pressure injury reported, there were no statistically significant associations between bridling and injury (2018).

The incidence of device related pressure injury will be tracked as a balancing measure to ensure patient harm does not result. Lastly, the literature review conducted prior to this project proposal provides strong evidence that bridling effectively decreases feeding tube dislodgement while increasing total delivered enteral nutrition. This quality improvement project has been classified as Non-Human Subjects Research through the University of Maryland Human Research Protections Office. Project implementation, data collection, and analysis were in compliance with both University of Maryland and the project site's requirements.

Results

Data collection was aided through the use of a daily report generated by the hospital system's electronic medical record. This report identified all patients in the project unit who had been included in the unit census for at least 24 hours, with orders for enteral nutrition for at least 24 hours. Any patient in the unit census for less than 24 hours or with less than 24 hours of enteral nutrition orders was not included in the data collection. By the end of the project, a total of 347 records were completed, with each record representing a single patient over a 24-hour period. Completed records included: the 24-hour period of time the audit reviewed, the method of nasoenteral tube securement, the 24-hour volume of enteral nutrition delivered, the 24-hour volume of enteral nutrition recommended by the registered dieticians, a calculated percentage of enteral nutrition delivered for the 24-hour period and whether the nasoenteral tube was inadvertently, requiring replacement; generating over 2,000 data points for analysis.

Nasal Bridal Utilization

Prior to project implementation, nasal bridal securement was utilized in only 7.1 % of patients requiring enteral nutrition. During the first five weeks of project implementation, overall nasal bridal utilization increased to 44.8% and continued to increase through week 10 with an

average bridal utilization of 65.1%. The final week of this project saw the highest intervention compliance with 88.9% of all nasoenteral feeding tubes secured via bridle.

Nasoenteral Tube Dislodgement

Prior to project implementation as many as 50% of nasoenterally fed patients experienced inadvertent tube dislodgement and subsequent interruptions in nutrition delivery. During the first 10 weeks of project implementation, the rate of tube dislodgement was reduced to just under 10% with the final 5 weeks of project implementation yielding a 5.7% rate of tube dislodgement among enterally fed patients. In fact, out of 204 instances of bridle securement, there were 0 instances of tube dislodgement across the 15-week implementation period. See Figure 6 in Appendix F for a run chart of nasoenteral tube dislodgement during this project.

Delivery of Enteral Nutrition

Lastly, baseline data collected prior to project implementation indicated that on average, patients in this intensive care unit were only receiving 42% of their recommended nutritional intake. The average delivery of enteral nutrition during the entire 15-week implementation phase of the project was nearly double baseline delivery at 82.1%. Delivery of nutrition continued to improve as project efforts sustained. During the last four weeks of project implementation, data collected demonstrated patients receiving over 88% of their recommended nutrition. See Figure 7 in the appendix for a run chart depicting pre- and post- implementation delivery of enteral nutrition in this intensive care unit.

Data Analysis

Further analysis of project data was conducted through descriptive statistics. First, summary tables (Appendix D) were constructed including each project measure. Out of 346 nasoenteral tube audits conducted, 204 were bridled, 30 were dislodged, and 229 successfully

delivered at least 80% of the recommended enteral nutrition. In fact, the overall mean for tube feeds delivered was 81% (*SD* = 0.26). Data was collected daily and then pooled into weekly tables (Appendix D) and run charts (Appendix F) depicting the impact of the implementation phase on both the process and outcome measures previously defined for this project. Through analysis of these run charts, it is clear this quality improvement initiative has improved bridle utilization, reduced nasoenteral tube dislodgement, and increased enteral nutrition delivery. First, Figure 5 demonstrates a consistent pos- implementation shift of increased bridle utilization. Next, when examining the rates of enteral tube dislodgement in Figure 6 compared to the rates of bridle utilization in Figure 5, it is evident that weeks with the highest utilization of nasal bridles correlate with decreased rates of tube dislodgement. Lastly, Figure 3 demonstrates a positive shift in nutrition delivery maintained throughout the entire implementation phase, indicating a consistent improvement in the delivery of nutrition throughout this phase of the project.

Next, Spearman correlation analysis was performed to examine the potential relationships between nasal bridling, tube dislodgement, and enteral nutrition delivery. A significant negative correlation between nasal bridling and tube dislodgement was observed. Tubes secured by nasal bridle were 35% ($p < .001$, 95.00% CI = [-.44, -.25]) less likely to become dislodged over the course of this project. Next, a significant positive correlation was observed between nasal bridle utilization and percent of enteral nutrition delivered. Patients with feeding tubes secured by bridle received 31% ($p < .001$, 95.00% CI = [.21, .40] more enteral nutrition.

Lastly, a linear regression analysis was conducted to assess whether the use of nasal bridle securement could significantly predict successful delivery of enteral nutrition. The results of this linear regression model were significant ($F(1,344) = 42.66$, $p < .001$, $R^2 = .11$) indicating that approximately 11.03% of the variance in the percent of enteral nutrition delivered is explainable by

whether or not a tube was secured with a bridle. See Appendix D for statistical analysis tables and Appendix F for correlation and regression analysis scatterplots.

Discussion

The results of this quality improvement project are consistent with those published by prior researchers included in the evidence review for this project. With the implementation of nasal bridles as the primary securement method, both the decrease in enteral tube dislodgement and the increase in enteral nutrition delivered were observed. Evidence demonstrates that improving enteral nutrition delivery directly reduces hospital acquired malnutrition and its adverse effects. While data was not collected regarding these sequelae, prior evidence indicates that this improved nutrition has the capability to reduce patient ventilator days, reduce hospital length of stay, and reduce the risk of developing hospital acquired infections and pressure injuries (Li et al., 2018) (Lynch et al., 2018).

Strengths and Limitations

Strengths of this project include heavy utilization of prior existing resources and structures. Unit culture pre-primed for process improvement and education served as a strong facilitator for intervention uptake. Staff nurse involvement was further motivated through the well-established clinical advancement ladder, incentivizing championship of the evidence based practice. Lastly, all materials required for intervention implementation were already available and stocked in unit supplies; cohorting these supplies together with visual cues provided staff with timely reminders of the practice change with minimal impact on nurse workload.

This project also has a number of limitations. Pre-Implementation educational rollout was limited to one week, reducing the spread of staff reached prior to project start. Next, this quality improvement project was specifically designed for implementation in this intensive care unit, potentially limiting the generalizability of these outcomes. Lastly, with implementation strategies

designed to promote staff awareness of their nasoenteral tube management and documentation, there is threat to the internal validity with the risk that the nutrition delivery improvements displayed throughout the course of the project may also be related to an overall improvement in nursing documentation and management practices.

Further Study

This project was unable to quantify the entire potential financial impact of nasal bridle utilization. Previous evidence has suggested not only a benefit in terms of reducing hospital acquired conditions and adverse events, as previously mentioned, but also discussed reduction in expenses directly related to reducing confirmatory chest and abdominal radiography utilized after replacing dislodged nasoenteral tubes. Future quality improvement projects capturing this data would be beneficial in understanding the full benefit of this intervention and provide further rationale for updating standard nursing practices.

Conclusion

This project demonstrates that nasal bridling is an effective method to reduce inadvertent tube dislodgement while increasing the delivery of enteral nutrition in this medical cardiovascular intensive care unit. Sustainability efforts were initiated along with project implementation through the development of unit champions, who will continue integrate and promote this evidence-based practice in unit culture. Next with significant positive feedback surrounding the “nasal bridling practice box” created to support project implementation, long term availability of this resource will continue to sustain project efforts beyond initial implementation. Furthermore, project processes and results have been disseminated through multiple streams of nursing leadership at this facility, fostering a collaborative interest in adapting this project for possible implementation in other critical care areas. Nasal bridles are a promising practice update that can likely be incorporated in many acute care settings.

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Appendix A

Table 1

Evidence Review Table

Citation: Bechtold, M. L., Nguyen, D. L., Palmer, L. B., Kiraly, L. N., Martindale, R. G., & McClave, S. A. (2015). *Nasal Bridles for Securing Nasoenteric Tubes: A Meta-Analysis*. 12. http://dx.doi.org.proxy-hs.researchport.umd.edu/10.1177/0884533614536737					Level II B
Purpose/ Hypothesis	Type of Evidence; Research Design	Sample	Intervention	Outcomes	Results
"This meta-analysis was performed to evaluate the effectiveness of nasal bridles compared with the traditional method of adhesive tape alone in securing enteral feeding tubes."	Research: Systematic Review with Meta-Analysis	Sampling Technique: A comprehensive literature search was performed from multiple databases. # Eligible: 63 46 articles and abstracts were excluded for not meeting inclusion criteria and 17 were read. Of those 17, 11 more were excluded: 8 for not having a control group, 2 for being letters to an editor, and one for subject of securement to an endotracheal tube. # Accepted: 6 5 articles were prospective cohort studies and 1 was a randomized control trial. All studies accepted compared nasal bridles with traditional adhesive tape and had completed datasets.	Control: Adhesive tape for nasogastric tube securement. Intervention: Bridling for nasogastric tube securement. Intervention Fidelity: No publication bias was noted for any of the outcomes in this meta-analysis based on funnel plots. Quality assessment of the studies based on the Effective Public Health Practice Project Scale was moderate for the prospective cohort studies and strong for the randomized control trial.	Dependent Variables: Dislodgement of the feeding tube was noted in 40% of the control group and only 14% of the intervention group. The use of a nasal bridles results in longer mean duration of feeding tube use (23 days vs 16 days; $p<.05$). The use of a bridle resulted in less meant tube replacements per day (0.26 vs 0.44; $p<.05$) and episodes of sinusitis (0% vs 6%; $p<0.05$).	Statistical Procedures(s) and Results: Statistical analysis was performed using RevMan 5.1. The use of a nasal bridle in patients with nasoenteric tubes was associated with a statistically significant reduction in tube dislodgement (OR, 0.16; 95% confidence interval [CI], 0.10=0.27; $p<.01$) compared with the use of traditional adhesive tape. Conclusion: Nasal bridles appear to be more effective at securing nasoenteric tubes than the use of

		Group Homogeneity: Mean age of the patients in these studies ranged from 48-66 years, and the nasoenteric tubes ranged from 8-16 French in size. No statistically significant heterogeneity was observed across these studies.			traditional adhesive tape alone.
Citation: Li, A. Y., Rustad, K. C., Long, C., Rivera, E., Mendiola, M., Schenone, M., & Karanas, Y. L. (2018). Reduced incidence of feeding tube dislodgement and missed feeds in burn patients with nasal bridle securement. *Burns*, 44(5), 1203–1209. https://doi.org/10.1016/j.burns.2017.05.025					Level and Quality II -B
Purpose/ Hypothesis	Type of Evidence; Research Design	Sample	Intervention	Outcomes	Results
"We aim to analyze the effectiveness of securing nasoenteric feeding tubes by a nasal bridle system compared to traditional adhesive methods."	Research: Prospective quasi-experimental case control study.	Sampling Technique: Convenience sampling of 74 patients admitted to a Burn ICU requiring nasoenteric nutritional support. # Eligible: 74 # Accepted: 74 # Control:33 # Intervention: 41 Power analysis: not discussed Group Homogeneity: Analysis of patients between the two treatment cohorts yielded no statistically significant differences in patient demographics including age, gender, injury mechanism, or TBSA involvement.	Control: Nasoenteric feeding tubes secured with traditional adhesive tape. Intervention: Nasoenteric feeding tubes secured with bridle systems. Intervention Fidelity: Applied Medical Technology Nasogastric bridles were placed according to manufacturer guidelines. Magnetic probes were passed through the nasopharynx, looped around the vomer bone, and secured to the feeding tube with a clip.	Dependent Variables: Patients with a nasal bridle received fewer total placed enteric feeding tubes per admission. The decreased frequency of feeding tube dislodgement in the nasal bridle group translated to fewer abdominal x-ray studies. A linear cost model demonstrated that while there was a higher initial direct cost for using the bridle system, this investment was later offset by decreases	Statistical Procedures(s) and Results: Using a Kaplan-Meier survival analysis to follow "tube survival" over time, researchers found feeding tubes secured with a bridle had a significantly longer functional life (p=.01) Patients with bridle securement only had 2.51 ± .95h or missed enteric feeds per admission compared to 6.72±2.07h of missed feeds in taped feeding tubes.

			Dislodgement was defined as any event that led to a removal of a feeding tube.	in costs associated with abdominal imaging utilization, estimated hospital provider time costs, and feeding tube replacement after dislodgement.	Mean number of feeding tubes placed in the intervention group was 1.15±0.07 compared to the control of 1.55±0.14 with a p-value of .009. Mean number of tube dislodgements per 10 days of feeding tube was 0.2±0.1 in the intervention group and 0.9±0.2 in the control group with a p-value of 0.005. <u>Conclusion</u>: Patients whose nasoenteric feeding tubes are secured with nasal bridles undergo significantly fewer dislodgement events. This translates to lengthened continuous feeding periods and reduced iatrogenic injury from tube replacement. Nasal bridle usage also results in cost reduction.
Citation: Lynch, A., Tang, C. S., Jeganathan, L. S., & Rockey, J. G. (2018). A systematic review of the effectiveness and complications of using nasal bridles to secure nasoenteral feeding tubes. *Australian Journal of Otolaryngology*, 1, 8–8. https://doi.org/10.21037/ajo.2018.01.01					Level II- B
Purpose/ Hypothesis	Type of Evidence; Research Design	Sample	Intervention	Outcomes	Results

"Systemic literature review regarding efficacy and complication rates of securing nasoenteral tubes with nasal bridles."	Systematic Review	Sampling Technique: Authors searched for published and unpublished articles in June 2014 across 7 medical databases. 2,750 titles were screened, 53 were identified as potential studies to include and 18 were included in the final review. For each included study, data extraction was conducted by one reviewer and verified by another. Data from more than 1,038 patients were included. (One study did not report the number of patients included in their study)	Control: Non-bridle methods of nasogastric securement including paper tape, tape designed for NGT, and other adhesive methods. Intervention: Bridle securement of nasogastric feeding tubes. Intervention Fidelity: Each study was reviewed for risk of bias.	Dependent Variables: The outcomes evaluated were rate of tube dislodgement, rate of tube replacement, tube dwelling time, quantified enteral nutrition, cost, complications – including emotional distress, and PEG related morbidity and mortality.	Statistical Procedures(s) and Results: Meta analysis reported: A tube dislodgment rate of 14% in bridled patients compared to 40% in adhesive tape secured patients OR 0.16, 955 ci:0.10-0.27, P<0.01) Eight studies reported a significant decrease in nasoenteral tube dislodgement with nasogastric bridling. Four studies reported nasoenteral tubes secured with nasal bridles to remain in situ for significantly longer. Two studies reported that nasal bridling reduced the number of radiographs done. Conclusion: Nasal bridling is associated with a lower rate of tube dislodgement, higher percentage of targeted feed received, decreased use of imaging, and potentially decreased

					costs and distress to the patient compared to conventional methods of securing nasogastric tubes.
Citation: Atkar, R., Clark, B., Eskell, M., & Arshad, M. A. (2021). The Use of Nasogastric Tube Bridle Kits in COVID-19 Intensive Care Unit Patients. 5. Retrieved February 7, 2022, from https://www.docdel.umaryland.edu/sso/illiad.dll?Action=10&Form=75&Value=508618					Level and Quality V-B
Purpose/ Hypothesis	Type of Evidence; Research Design	Sample	Intervention	Outcomes	Results
"To ascertain the extent of nasogastric tube (NGT) dislodgement in COVID-19 intensive care unit (ICU) patients after the introduction of NGT bridle kits as a standard of practice, to see whether this would reduce the number of NGT insertions, patient irradiation, missed feeds, and overall cost."	Practice: A two-cycle quality improvement project. The first cycle was done retrospectively, observing data without the use of NGT bridles. The second was prospectively, with the NGT bridle kits established as the new standard of practice.	<u>Sampling Technique:</u> Convenience sampling of all COVID-19 patients admitted to a large academic teaching hospital CCU in the United Kingdom. # Eligible: 54 # Accepted: 54 # Control: 23 # Intervention: 31 <u>Power analysis:</u> not discussed <u>Group Homogeneity:</u> not discussed	<u>Control:</u> NGT secured with tape <u>Intervention</u>: NGT secured with bridle <u>Intervention fidelity:</u> Nurses on the CCU received specialized training in the correct placement of NGT bridles and then incorporated NGT bridle documentation in their EMR. EMR documentation included in data collection included: - # Of days of feeding - Hours of feeding missed due to tube dislodgement - # Of NGT insertions	<u>Dependent Variables:</u> Incidence of feeding tube replacement as documented in the EMR. Incidence of radiographs ordered for confirmation of placement as documented in the EMR. Hours of feeding missed due to tube dislodgement. Incidence of pressure injury related to bridling of the nasogastric tube.	<u>Statistical Procedures(s) and Results:</u> The average number of NGT and CXR per patient in the control and intervention groups were calculated with a T-test and a p-value <.01. On average bridled patients required 1.3 NGTs compared to 2.5 in patients without NGT bridles. The average number of CXR to confirm tube placement decreased from 3.4 in the control to 1.6 in the intervention group.

			- # Of CXR for NGT positioning - Bridling of NGT - Documented pressure injury related to NGT bridle		The mean hours of feeding missed due to NGT displacement was also decreased in the intervention group (5 hours) compared to the control group (11.8 hours). <u>Conclusion:</u> The use of NGT bridle kits reduces the number of NGT insertions patients require and subsequently reduces the number of chest radiographs for each patient. These patients also miss fewer feeds, with no appreciable increase in cost.
Citation: Allan, K., Taylor, S., Clemente, R., & Toher, D. (2019). Observation of inadvertent tube loss in ICU: Effect of nasal bridles. *British Journal of Nursing*, *28*(18), 1170–1174. https://doi.org/10.12968/bjon.2019.28.18.1170					Level and Quality II-B
Purpose/ Hypothesis	Type of Evidence; Research Design	Sample	Intervention	Outcomes	Results
"To review current nasal bridle practices on one intensive care unit."	Research Retrospective nonrandomized quasi-experimental study.	Sampling Technique: Convenience sampling of all ICU patients with a NG or NI tube in place between October 2017 and January 2018 # Eligible: 109 # Accepted: 109 # Control:63 # Intervention: 46	<u>Control</u>: Nasogastric or nasointestinal tube securement with tape. <u>Intervention</u>: Nasogastric or nasointestinal tube securement with bridle system. <u>Intervention Fidelity:</u>	<u>Dependent Variables:</u> Incidence of feeding tube loss. Length of feeding tube duration. Prevalence of a single feeding tube reaching redundancy (being no longer needed)	<u>Statistical Procedures(s) and Results:</u> Regression analysis showed that nasal bridles reduced the risk of tube loss by 82% (OR 0.18, 95% confidence interval [CI}:0.09-0.035), improved the tube duration by 5.7 days (95% CI: 2.11 -9.21)

		Power analysis: A power calculation showed that 102 patients (51 bridled and 51 unbridled) were required for the study to have a power of 90% to detect a difference at a significance level of 0/05. <u>Group Homogeneity:</u> There are no statistically significant differences in age, gender, or APACHE II score between the two groups.	Nurses on the intensive care unit received training workshops in bridling technique. Feed tube loss was defined as unintentional feeding tube removal or dislodgement that renders a feeding tube unusable. Feeding tube duration was calculated from documented time of insertion to documented time of removal (either purposeful or unintentional).		and tubes were three times more likely to reach redundancy when a bridle was used (OR:3.0, 95% CI: 1.59-5.81). When compared with tubes secured with a bridle at day 1, unbridled tubes were more likely to be prematurely lost (17.4% versus 57.1% respectively, P<0.0001). Use of bridles was associated with reduced patient removal (13% versus 41.3%) and slippage (2.2% versus 9.5%) <u>Conclusion</u>: Nasal bridles appear to improve NG and NI tube retention in critically ill patients. Improved tube retention using a bridle is likely to reduce the number of tube misplacements (such as the tube entering the lung) because fewer tubes are needed per patient. Additionally, bridles improve

					nutrition and drug delivery and therefore treatment efficacy.
Citation: Brugnolli, A., Ambrosi, E., Canzan, F., & Saiani, L. (2014). Securing of naso-gastric tubes in adult patients: A Review. *International Journal of Nursing Studies*, 51(6), 943–950. https://doi.org/10.1016/j.ijnurstu.2013.12.002					Level and Quality II - C
Purpose/ Hypothesis	Type of Evidence; Research Design	Sample	Intervention	Outcomes	Results
"To establish the most effective securing devices and techniques for preventing nasogastric tube displacement or inadvertent extubation, mucosa and skin lesions, discomfort, and complications in adult patients."	Research: Systematic Review	Sampling Technique: Eligibility criteria: Systematic reviews, randomized control trials, and comparative studies that compared at leat 2 techniques or devices to secure nasogastric tubes in patients 18 or older. 5404 references were garnered from search criteria and 5387 were excluded. Authors excluded case reports, editorials, letters, expert opinions, comments, and studies referring only to a pediatric population. The remaining 17 resources were examined and met inclusion criteria. <u>Group Homogeneity:</u> The populations included in these studies were all adult	Four studies reported on bridle versus tape technique for tube securement. Three studies compared bridled and unbridled patients measured adverse events such as nasal ulceration, epistaxis, and sinusitis. One study measured caloric intake in bridled versus unbridled patients. One study analyzed the cost effectiveness of the bridle versus tape technique. <u>Intervention Fidelity:</u> Blinding was deemed not adequate with high risk of bias in 4 out of the 5 included studies.	<u>Dependent Variables</u>: The primary outcomes measured included: - Tube dwelling time - Nasogastric tube unplanned extubation or dislodgement - Feeding tube replacement - Patient discomfort - Complications (lesions to skin or mucosa, reduced caloric intake) Secondary Outcomes: - Nurse satisfaction and cost - Mortality	Statistical Procedures(s) and Results: Three studies found a statistically significant improvement in the rate of unintentional dislodgment or removal of nasogastric tubes with bridles when compared to other methods ($p<0.001$, $p=0.004$ and $p<0.0001$). One study used Kaplan Meir survival analysis to determine that the bridle method of tube securement had a decreased unintentional tube removal rate per 100 days ($p=0.006$). One study measured caloric intake and determined that bridled patients received a higher percentage of their caloric goal than

		patients admitted to intensive care units. 335 patients in total	1 out of the 5 studies appeared to have incomplete data that was not addressed and assessed to have a high risk of bias.		unbridled patients (p=0.016). <u>Conclusion</u>: Despite the large number of patients receiving this intervention, there is insufficient quality of evidence to suggest one securing technique over another. There is a need for more well-designed studies conducted in various clinical settings.

Appendix B

Table 2
Synthesis Table

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings
Level 1 - Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis	----------	----------	----------
Level II · Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis	3 Systemic Reviews of RCT and Quasi Experimental Studies 2 Quasi-Experimental Studies	B	All studies found that the practice of utilizing nasogastric bridles to secure nasogastric feeding tubes reduces the incidence and prevalence of gastric tube dislodgement, replacement, confirmatory radiography, and loss of feeding time when compared to traditional adhesive securement. This translates to costs savings and improved patient outcomes.
Level III · Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis	----------	----------	----------
Level IV · Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence	----------	----------	----------
Level V · Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence	1 Quality Improvement Project	B	The use of NGT bridle kits reduced the number of NGT insertions patients required. This subsequently reduced the number of chest radiographs for each patient. These patients also miss fewer feeds, increasing their caloric intake, without an appreciable increase in cost.
Recommendations Based on Evidence Synthesis: The quality of the evidence is good. The evidence consistently supports the adoption of nasal bridles for the securement of nasogastric feeding tubes in critical care units.			

Appendix C

Table 3

Implementation Strategies

Accountability		
Strategies	Specific Tactics	Rationale/Effectiveness
Obtain Formal Commitments	Traditional education sessions and roaming workshops will be held to capture 100% of staff in educating nasobridle placement and practice change. Nurses and CNAs will be asked to commit to practice change at the end the workshop. Nurses interested in championing implementation will be identified and offered clinical advancement opportunity for supporting initiative.	Staff training will facilitate practice change through stakeholder buy in, overcoming barriers to change, and informing the rationale behind practice change. To evaluate the effectiveness of training all staff members the staff roster will be compared to training roster. Champions will be committed to facilitating practice change through outlined responsibilities (helping with placement, reminding staff)
Provide Clinical Supervision	Training sessions will include supervised hands-on practice opportunities.	Project lead, unit leaders, and superusers will promote the intervention through unit rounding and education. Effectiveness will be evaluated through rounds and training session feedback.
Provide Performance Review	Training sessions will end with nurses demonstrating correct placement and receiving a signed competency. Compliance with NGT securement by nasal bridle will be posted on the unit.	Providing positive feedback at the end of sessions will promote intervention uptake.
Buy-In (Incentives/Disincentives)		
Strategies	Specific Tactics	Rationale/Effectiveness
Offer “Superuser” Credits for Clinical Advancement Program (CAP)	The clinical advancement program offers opportunities for nurses to earn an annual bonus correlating to the number of “CAP points” accumulated. Superuser role can include but is not limited to assisting another	CAP superusers must document the number of staff they capture in their superuser role. Superusers will act as additional change agents for the intervention.

	nurse, providing additional education, auditing clinical practices, and auditing the electronic medical record. Fulfilling the "Superuser" requirements in CAP will earn the nurse 5 points.	Superuser efforts will be documented in order to qualify for points. This documentation can also be used to evaluate superuser effectiveness. Promoting earning CAP points also supports the nurses involved in the project and fosters a positive environment for evidence-based practice changes.
Offer Continuing Education Units (CEU) for Workshop Attendance	Workshops and sessions can be made eligible for contact hours through collaboration with unit educators.	Offering continuing education credits in collaboration with education department will provide additional incentive for attendance and involvement. CEUs will be recorded in the SiTEL education bank and available for licensing needs.
"Superstar" Shout Outs	Staff contributing to the success of the intervention will be recognized with MedStar "SuperStar" Shout Outs. MedStar "SuperStar" shout outs are recorded and can be redeemed for 1 CAP point. CAP points can be redeemed once a year for a bonus based on the number of points accrued.	Positively recognizing staff efforts will foster support for the initiative. Promoting earning CAP points also supports the nurses involved in the project and fosters a positive environment for evidence-based practice changes.
Collaboration, Communication, and Changes in Structures		
Strategies	Specific Tactics	Rationale/Effectiveness
Identify Early Adopters	Workshops will provide opportunities for staff to express interest in being Superusers and support implementing nasobridling as the primary securement method.	Superusers will act as additional change agents for the intervention. Superuser efforts will be documented in order to qualify for points. This documentation can also be used to evaluate superuser effectiveness.

Remind Clinicians	Educational posters will be posted throughout the "educational corners." Posters and reminders will be posted near the NGT and bridling supplies to serve as additional reminder. Project implementation will be featured in huddle topics, unit newsletter, bathroom, and break room bulletin board updates.	Multimodal approaches to reminding clinicians will keep project information fresh and readily available. Shared "Success Rate" data will provide feedback and evaluate the effectiveness of interventions supporting project implementation.
Share Information in a Public and Transparent Manner	"Success Rate" data for the use of nasal bridles as the primary method for securing nasogastric tubes will be posted on unit bulletin boards.	Shared "Success Rate" data will provide feedback and evaluate the effectiveness of interventions supporting project implementation.
Promote Network Weaving	Existing education resources including the unit educator and standing Monday Education Sessions will be used for implementation support of the project.	Building on current structures increases likelihood of long-term intervention sustainability.
Change Physical Structure of Storage	All bridling supplies will be stored near the nasogastric tube supplies. Bridles and nasogastric tube bins will be color coded for easy identification of needed supplies.	Updating supply storage will improve and simplify staff workflow. Staff feedback will evaluate effectiveness of storage updates.
Data		
Strategies	Specific Tactics	Rationale/Effectiveness
Complete Audits and Provide Feedback	Charts will be audited for data extraction to include: - Method of NGT securement - Total volume of TF delivered - Volume of recommended TF - If NGT was dislodged and replaced	Periodic data will be shared with staff and unit leaders for monitoring and tracking progress towards decreasing NGT dislodgement increasing overall delivery of enteral nutrition. Data shared will double as method for evaluating project intervention effectiveness.
Tailor Strategies	Barriers are addressed through workshop trainings and supply storage.	Implementation strategies address barriers and leverage facilitators for successful project implementation.

	Facilitators are utilized through workshops and unit resource sharing.	Workshop training success and staff feedback will evaluate effectiveness of the strategies.
Education		
Strategies	Specific Tactics	Rationale/Effectiveness
Conduct Ongoing Training	Ongoing training will be provided by unit superusers both during the short term of project implementation and long term for sustainability of the implementation.	Continuing training throughout the entire project and after the project will support sustained implementation. Workshop training attendance and staff feedback will evaluate effectiveness of education strategies.
Set Up Classes	Standing Monday Education Sessions will be utilized as a workshop for learning bridling technique. Mobile workshops will include project lead, educators, and superusers rounding on the unit and providing training at the bedside.	Formal education will be geared towards the intervention and allow for staff to understand why the practice change is occurring and how to participate in the change. Workshop training attendance and staff feedback will evaluate effectiveness of education strategies.
Provide Demonstrations	Standing Monday Education Sessions will be utilized as a workshop for learning bridling technique. Mobile workshops will include project lead, educators, and superusers rounding on the unit and providing training at the bedside.	Workshop training attendance and staff feedback will evaluate effectiveness of education strategies.
Use “Train the Trainer” Strategies	To receive training competency, nurses will demonstrate bridling technique and teach back.	Workshop training attendance and staff feedback will evaluate effectiveness of education strategies.
Develop and Distribute Educational Materials	Fliers and posters will be made and posted throughout the unit in education corners, bulletin boards, under wow bladders, and storage room.	Workshop training attendance and staff feedback will evaluate effectiveness of education strategies.
Make Training Dynamic	Education will be available through paper resources, video and in person demonstrations, and hands-on practice.	Education methods will be available to suit a variety of learning styles and the dynamic environment of the nursing unit.

	Resources will be made available outside of workshops to allow staff to learn and practice when it best fits their own schedule.	Nursing availability for training can be unpredictable, having a resource available for practice will help capture more staff in the training.

Appendix D

Table 4

Summary Frequency Table

Variable	*n*	*%*
Was at least 80% of the Recommended Nutrition Delivered?		
Yes	229	66.18
No	117	33.82
Was the Nasoenteral Tube Bridled?		
No	142	41.04
Yes	204	58.96
Was the Nasoenteral Tube Dislodged?		
No	316	91.33
Yes	30	8.67

Table 5

Summary Statistics Table for Enteral Nutrition Delivery

Variable	*M*	*SD*	*n*	SE_M	Min	Max	Skewness	Kurtosis
24hour Volume Delivered	870.81	360.28	346	19.37	0.00	1,900.00	-0.21	0.12
24hour Volume Recommended	1,065.95	299.72	346	16.11	500.00	1,950.00	0.50	-0.14
Percent Delivered	0.81	0.26	346	0.01	0.00	1.60	-1.10	1.87

Table 6

Summary Statistics by Week

Project Week	Percent Bridled	Percent Delivered	Percent Dislodged
Week 1	0.2143	0.5876	0.1786
Week 2	0.1786	0.6819	0.1053
Week 3	0.4545	0.8291	0.0909
Week 4	0.8181	0.8980	0.0455
Week 5	0.5757	0.8151	0.0909
Week 6	0.6428	0.7678	0.0000
Week 7	0.8333	0.8122	0.1667
Week 8	0.7727	0.8021	0.0454
Week 9	0.4706	0.8361	0.1760
Week 10	0.5380	0.8740	0.0769

Week 11	0.6429	0.8740	0.1071
Week 12	0.5000	0.9253	0.0454
Week 13	0.6500	0.9685	0.0870
Week 14	0.6818	0.8882	0.0455
Week 15	0.8213	0.8213	0.0000

Table 7

Spearman Correlation Results Among BridleStatus, Tube_Dislodged, and Percent_Delivered

Combination	*r*	95.00% CI	*n*	*p*
BridleStatus-Tube_Dislodged	-.35	[-.44, -.25]	346	< .001
BridleStatus-Percent_Delivered	.31	[.21, .40]	346	< .001
Tube_Dislodged-Percent_Delivered	-.35	[-.44, -.26]	346	< .001

Table 8

Results for Linear Regression with BridleStatus predicting Percent_Delivered

Variable	*B*	*SE*	95.00% CI	β	*t*	*p*
(Intercept)	0.71	0.02	[0.67, 0.75]	0.00	34.08	< .001
BridleStatusYes	0.18	0.03	[0.12, 0.23]	0.33	6.53	< .001

Note. Results: $F(1,344) = 42.66$, $p < .001$, $R^2 = .11$
Unstandardized Regression Equation: Percent_Delivered = 0.71 + 0.18*BridleStatusYes

Appendix E

Table 9

Project Data Set

Record #	Date	Bridled? Yes/No	24 hour Delivered	24 hour Recommended	NGT Dislodged	Percent Delivered	At least 80%?
1	8/29/2022	No	1187	1170	No	1.01453	Yes
2	8/29/2022	No	1125	1530	No	0.735294	No
3	8/29/2022	No	243	1380	No	0.176087	No
4	8/29/2022	Yes	914	935	No	0.97754	Yes
5	8/30/2022	No	799	1540	No	0.518831	No
6	8/31/2022	No	232	1540	No	0.150649	No
7	8/30/2022	No	1238	1260	No	0.98254	Yes
8	8/31/2022	No	676	720	No	0.938889	Yes
9	8/31/2022	No	300	960	No	0.3125	No
10	8/31/2022	No	0	960	Yes	0	No
11	8/30/2022	Yes	757	630	No	1.201587	Yes
12	8/31/2022	Yes	710	630	No	1.126984	Yes
13	9/1/2022	No	498	900	Yes	0.553333	No
14	9/1/2022	No	657	720	No	0.9125	Yes
15	9/1/2022	No	637	960	No	0.663542	No
16	9/1/2022	No	0	960	No	0	No
17	9/1/2022	Yes	662	630	No	1.050794	Yes
18	9/2/2022	No	699	900	No	0.776667	No
19	9/2/2022	No	430	720	No	0.597222	No
20	9/2/2022	No	306	1120	Yes	0.273214	No
21	9/2/2022	No	453	720	No	0.629167	No
22	9/2/2022	No	0	960	No	0	No
23	9/2/2022	No	522	960	No	0.54375	No
24	9/2/2022	Yes	600	630	No	0.952381	Yes
25	9/3/2022	No	230	720	No	0.319444	No
26	9/4/2022	No	351	720	No	0.4875	No
27	9/3/2022	No	45	720	Yes	0.0625	No
28	9/5/2022	No	230	720	No	0.319444	No
29	9/4/2022	No	70	720	No	0.097222	No
30	9/3/2022	No	40	720	Yes	0.055556	No
31	9/5/2022	No	430	640	No	0.671875	No
32	9/5/2022	No	174	720	Yes	0.241667	No
33	9/5/2022	No	138	640	Yes	0.215625	No
34	9/5/2022	No	180	540	No	0.333333	No
35	9/5/2022	Yes	840	635	No	1.322835	Yes
36	9/4/2022	Yes	805	635	No	1.267717	Yes
37	9/3/2022	Yes	588	635	No	0.925984	Yes

38	9/7/2022	No	330	810	No	0.407407	No
39	9/6/2022	No	323	810	No	0.398765	No
40	9/5/2022	No	0	810	Yes	0	No
41	9/4/2022	No	0	810	No	0	No
42	9/7/2022	No	480	720	No	0.666667	No
43	9/6/2022	No	230	720	No	0.319444	No
44	9/4/2022	No	180	720	No	0.25	No
45	9/4/2022	No	160	720	No	0.222222	No
46	9/7/2022	No	280	640	No	0.4375	No
47	9/7/2022	No	712	540	No	1.318519	Yes
48	9/6/2022	No	635	540	No	1.175926	Yes
49	9/5/2022	No	180	540	Yes	0.333333	No
50	9/7/2022	Yes	539	550	No	0.98	Yes
51	9/6/2022	Yes	650	680	No	0.955882	Yes
52	9/5/2022	Yes	665	680	No	0.977941	Yes
53	9/4/2022	Yes	670	680	No	0.985294	Yes
54	9/8/2022	Yes	1135	1000	No	1.135	Yes
55	9/9/2022	Yes	1005	1000	No	1.005	Yes
56	9/10/2022	Yes	995	1000	No	0.995	Yes
57	9/11/2022	Yes	975	1000	No	0.975	Yes
58	9/12/2022	Yes	960	1000	No	0.96	Yes
59	9/8/2022	Yes	770	770	No	1	Yes
60	9/9/2022	Yes	750	770	No	0.974026	Yes
61	9/10/2022	Yes	750	770	No	0.974026	Yes
62	9/11/2022	Yes	720	770	No	0.935065	Yes
63	9/12/2022	Yes	720	770	No	0.935065	Yes
64	9/8/2022	Yes	850	850	No	1	Yes
65	9/9/2022	Yes	850	850	No	1	Yes
66	9/10/2022	No	680	900	No	0.755556	No
67	9/11/2022	No	775	900	No	0.861111	Yes
68	9/12/2022	Yes	543	600	No	0.905	Yes
69	9/8/2022	No	910	1200	No	0.758333	No
70	9/9/2022	No	820	1200	No	0.683333	No
71	9/10/2022	No	350	630	No	0.555556	No
72	9/11/2022	No	450	630	No	0.714286	No
73	9/12/2022	No	450	630	No	0.714286	No
74	9/11/2022	Yes	725	850	No	0.852941	Yes
75	9/12/2022	No	700	850	Yes	0.823529	Yes
76	9/10/2022	Yes	800	1160	No	0.689655	No
77	9/11/2022	No	815	1160	Yes	0.702586	No
78	9/12/2022	No	829	1160	No	0.714655	No
79	9/13/2022	Yes	900	1000	No	0.9	Yes
80	9/13/2022	No	980	1250	No	0.784	No
81	9/14/2022	Yes	1250	1300	No	0.961538	Yes

82	9/14/2022	No	1800	1800	No	1	Yes
83	9/15/2022	Yes	1000	1000	No	1	Yes
84	9/16/2022	No	1200	1250	No	0.96	Yes
85	9/17/2022	Yes	1000	1500	No	0.666667	No
86	9/17/2022	No	700	1200	No	0.583333	No
87	9/17/2022	No	800	1200	No	0.666667	No
88	9/17/2022	No	1000	1600	No	0.625	No
89	9/18/2022	Yes	800	900	No	0.888889	Yes
90	9/18/2022	No	700	750	No	0.933333	Yes
91	9/18/2022	No	500	1100	Yes	0.454545	No
92	9/18/2022	No	600	1200	No	0.5	No
93	9/19/2022	Yes	600	900	No	0.666667	No
94	9/19/2022	Yes	1000	1300	No	0.769231	No
95	9/19/2022	No	1600	1600	No	1	Yes
96	9/19/2022	Yes	1500	1500	No	1	Yes
97	9/20/2022	Yes	1100	1100	No	1	Yes
98	9/20/2022	Yes	900	1100	No	0.818182	Yes
99	9/20/2022	Yes	980	900	No	1.088889	Yes
100	9/21/2022	Yes	888	900	No	0.986667	Yes
101	9/21/2022	Yes	1150	1250	No	0.92	Yes
102	9/22/2022	Yes	1300	1250	No	1.04	Yes
103	9/22/2022	Yes	980	1000	No	0.98	Yes
104	9/22/2022	Yes	1100	1250	No	0.88	Yes
105	9/23/2022	Yes	800	900	No	0.888889	Yes
106	9/23/2022	Yes	800	750	No	1.066667	Yes
107	9/23/2022	Yes	800	900	No	0.888889	Yes
108	9/24/2022	Yes	800	750	No	1.066667	Yes
109	9/24/2022	Yes	900	1000	No	0.9	Yes
110	9/24/2022	Yes	1120	1100	No	1.018182	Yes
111	9/25/2022	Yes	885	900	No	0.983333	Yes
112	9/25/2022	Yes	250	600	No	0.416667	No
113	9/25/2022	Yes	650	800	No	0.8125	Yes
114	9/25/2022	No	500	1000	Yes	0.5	No
115	9/25/2022	No	300	800	No	0.375	No
116	9/26/2022	Yes	500	1100	No	0.454545	No
117	9/26/2022	No	1110	1250	No	0.888	Yes
118	9/26/2022	Yes	935	1400	No	0.667857	No
119	9/26/2022	Yes	775	1000	No	0.775	No
120	9/26/2022	Yes	730	800	No	0.9125	Yes
121	9/27/2022	No	825	1000	No	0.825	Yes
122	9/27/2022	No	730	900	No	0.811111	Yes
123	9/27/2022	Yes	900	1100	No	0.818182	Yes
124	9/27/2022	No	950	1250	No	0.76	No
125	9/27/2022	No	800	900	Yes	0.888889	Yes

126	9/27/2022	Yes	700	900	No	0.777778	No
127	9/28/2022	Yes	800	1100	No	0.727273	No
128	9/28/2022	Yes	900	900	No	1	Yes
129	9/28/2022	No	1100	1000	No	1.1	Yes
130	9/29/2022	No	995	1100	No	0.904545	Yes
131	9/29/2022	Yes	930	900	No	1.033333	Yes
132	9/29/2022	Yes	1000	1100	No	0.909091	Yes
133	9/29/2022	Yes	1100	1200	No	0.916667	Yes
134	9/30/2022	No	845	900	No	0.938889	Yes
135	9/30/2022	No	1400	1200	No	1.166667	Yes
136	9/30/2022	Yes	700	900	No	0.777778	No
137	9/30/2022	Yes	930	1100	No	0.845455	Yes
138	9/30/2022	No	770	900	No	0.855556	Yes
139	9/30/2022	Yes	900	1100	No	0.818182	Yes
140	9/30/2022	Yes	1035	1200	No	0.8625	Yes
141	10/1/2022	Yes	650	900	No	0.722222	No
142	10/1/2022	No	540	750	Yes	0.72	No
143	10/1/2022	No	700	750	No	0.933333	Yes
144	10/2/2022	No	815	900	No	0.905556	Yes
145	10/2/2022	Yes	150	1100	No	0.136364	No
146	10/3/2022	No	490	900	No	0.544444	No
147	10/3/2022	Yes	800	1000	No	0.8	Yes
148	10/4/2022	No	450	900	No	0.5	No
149	10/4/2022	Yes	1370	1500	No	0.913333	Yes
150	10/4/2022	Yes	900	1000	No	0.9	Yes
151	10/5/2022	Yes	975	1200	No	0.8125	Yes
152	10/6/2022	Yes	1100	1500	No	0.733333	No
153	10/6/2022	Yes	890	1000	No	0.89	Yes
154	10/7/2022	Yes	1100	1200	No	0.916667	Yes
155	10/7/2022	Yes	800	900	No	0.888889	Yes
156	10/8/2022	No	900	1100	No	0.818182	Yes
157	10/8/2022	No	990	1000	No	0.99	Yes
158	10/9/2022	Yes	800	700	No	1.142857	Yes
159	10/9/2022	Yes	600	500	No	1.2	Yes
160	10/10/2022	Yes	800	900	No	0.888889	Yes
161	10/11/2022	Yes	0	650	No	0	No
162	10/12/2022	Yes	700	1000	No	0.7	No
163	10/13/2022	No	955	1100	Yes	0.868182	Yes
164	10/13/2022	Yes	1100	1200	No	0.916667	Yes
165	10/13/2022	No	700	900	Yes	0.777778	No
166	10/14/2022	Yes	700	700	No	1	Yes
167	10/14/2022	Yes	500	800	No	0.625	No
168	10/15/2022	Yes	700	900	No	0.777778	No
169	10/15/2022	Yes	850	1000	No	0.85	Yes

170	10/16/2022	Yes	850	1100	No	0.772727	No
171	10/16/2022	Yes	750	900	No	0.833333	Yes
172	10/16/2022	Yes	1250	1000	No	1.25	Yes
173	10/17/2022	Yes	850	1000	No	0.85	Yes
174	10/17/2022	No	1400	1500	No	0.933333	Yes
175	10/17/2022	Yes	1650	1780	No	0.926966	Yes
176	10/18/2022	Yes	650	1950	No	0.333333	No
177	10/18/2022	No	1150	1100	No	1.045455	Yes
178	10/18/2022	Yes	950	1300	No	0.730769	No
179	10/18/2022	Yes	1500	1700	No	0.882353	Yes
180	10/19/2022	No	750	860	No	0.872093	Yes
181	10/19/2022	No	1100	1200	No	0.916667	Yes
182	10/19/2022	Yes	1050	1200	No	0.875	Yes
183	10/20/2022	Yes	1300	1300	No	1	Yes
184	10/20/2022	Yes	1550	1500	No	1.033333	Yes
185	10/21/2022	Yes	1400	1450	No	0.965517	Yes
186	10/21/2022	Yes	1300	1800	No	0.722222	No
187	10/22/2022	Yes	400	1700	No	0.235294	No
188	10/22/2022	Yes	1100	1500	No	0.733333	No
189	10/22/2022	No	500	900	Yes	0.555556	No
190	10/23/2022	No	900	1100	No	0.818182	Yes
191	10/23/2022	Yes	1300	1500	No	0.866667	Yes
192	10/23/2022	Yes	1450	1700	No	0.852941	Yes
193	10/23/2022	Yes	1380	1500	No	0.92	Yes
194	10/24/2022	Yes	1100	1500	No	0.733333	No
195	10/24/2022	No	1550	1700	No	0.911765	Yes
196	10/25/2022	Yes	600	950	No	0.631579	No
197	10/26/2022	No	880	1000	No	0.88	Yes
198	10/26/2022	Yes	1000	1150	No	0.869565	Yes
199	10/27/2022	No	1100	1400	Yes	0.785714	No
200	10/28/2022	No	900	1100	No	0.818182	Yes
201	10/28/2022	Yes	1200	900	No	1.333333	Yes
202	10/28/2022	No	250	500	Yes	0.5	No
203	10/28/2022	No	670	1100	No	0.609091	No
204	10/29/2022	No	800	900	No	0.888889	Yes
205	10/29/2022	No	500	750	Yes	0.666667	No
206	10/29/2022	Yes	1100	1200	No	0.916667	Yes
207	10/30/2022	Yes	900	1200	No	0.75	No
208	10/30/2022	Yes	1100	1300	No	0.846154	Yes
209	10/31/2022	No	1550	1800	No	0.861111	Yes
210	10/31/2022	No	1130	1200	No	0.941667	Yes
211	11/1/2022	Yes	1100	1400	No	0.785714	No
212	11/1/2022	No	855	1200	Yes	0.7125	No
213	11/2/2022	Yes	1100	1200	No	0.916667	Yes

214	11/2/2022	No	1150	1400	No	0.821429	Yes
215	11/3/2022	No	50	1200	No	0.041667	No
216	11/4/2022	Yes	920	1200	No	0.766667	No
217	11/4/2022	Yes	700	900	No	0.777778	No
218	11/5/2022	No	1200	750	No	1.6	Yes
219	11/5/2022	Yes	910	900	No	1.011111	Yes
220	11/6/2022	Yes	860	1000	No	0.86	Yes
221	11/6/2022	Yes	930	1000	No	0.93	Yes
222	11/6/2022	Yes	1300	1400	No	0.928571	Yes
223	11/6/2022	No	940	1000	No	0.94	Yes
224	11/7/2022	Yes	1300	1580	No	0.822785	Yes
225	11/7/2022	No	1290	1450	No	0.889655	Yes
226	11/7/2022	Yes	1100	1150	No	0.956522	Yes
227	11/7/2022	Yes	1200	1100	No	1.090909	Yes
228	11/7/2022	No	300	1300	Yes	0.230769	No
229	11/8/2022	Yes	940	1150	No	0.817391	Yes
230	11/8/2022	Yes	1050	1100	No	0.954545	Yes
231	11/8/2022	No	750	1100	Yes	0.681818	No
232	11/8/2022	Yes	800	900	No	0.888889	Yes
234	11/9/2022	Yes	1100	1200	No	0.916667	Yes
235	11/9/2022	Yes	1500	1100	No	1.363636	Yes
236	11/10/2022	Yes	1300	1200	No	1.083333	Yes
237	11/10/2022	No	900	1100	No	0.818182	Yes
238	11/10/2022	Yes	650	800	No	0.8125	Yes
239	11/10/2022	No	1050	1400	No	0.75	No
240	11/10/2022	Yes	840	950	No	0.884211	Yes
241	11/11/2022	No	980	1100	No	0.890909	Yes
242	11/11/2022	Yes	1150	1200	No	0.958333	Yes
243	11/11/2022	Yes	670	950	No	0.705263	No
244	11/11/2022	No	445	800	Yes	0.55625	No
245	11/12/2022	No	850	950	No	0.894737	Yes
246	11/12/2022	No	970	1200	No	0.808333	Yes
247	11/12/2022	Yes	1200	1200	No	1	Yes
248	11/12/2022	Yes	1500	1500	No	1	Yes
249	11/13/2022	No	380	1000	Yes	0.38	No
250	11/13/2022	No	690	1000	No	0.69	No
251	11/13/2022	Yes	1100	1200	No	0.916667	Yes
252	11/13/2022	No	1200	1300	No	0.923077	Yes
253	11/14/2022	No	890	1000	No	0.89	Yes
254	11/14/2022	No	950	1000	No	0.95	Yes
255	11/14/2022	No	1275	1250	No	1.02	Yes
256	11/14/2022	Yes	980	1000	No	0.98	Yes
257	11/15/2022	Yes	1375	1500	No	0.916667	Yes
258	11/15/2022	Yes	680	800	No	0.85	Yes

259	11/15/2022	No	1300	1300	No	1	Yes
260	11/15/2022	Yes	1400	1400	No	1	Yes
261	11/15/2022	No	750	900	No	0.833333	Yes
262	11/16/2022	No	900	750	No	1.2	Yes
263	11/16/2022	No	750	750	No	1	Yes
264	11/16/2022	Yes	1500	1400	No	1.071429	Yes
265	11/16/2022	Yes	1260	1400	No	0.9	Yes
266	11/17/2022	Yes	1150	1200	No	0.958333	Yes
267	11/17/2022	No	1900	1800	No	1.055556	Yes
268	11/18/2022	Yes	800	900	No	0.888889	Yes
269	11/18/2022	Yes	750	900	No	0.833333	Yes
270	11/19/2022	Yes	1200	1300	No	0.923077	Yes
271	11/20/2022	No	1300	1400	No	0.928571	Yes
272	11/21/2022	Yes	850	950	No	0.894737	Yes
273	11/21/2022	No	1050	1100	No	0.954545	Yes
274	11/21/2022	Yes	800	750	No	1.066667	Yes
275	11/22/2022	No	780	500	No	1.56	Yes
276	11/22/2022	Yes	900	1000	No	0.9	Yes
277	11/22/2022	Yes	1100	1200	No	0.916667	Yes
278	11/22/2022	Yes	1150	1200	No	0.958333	Yes
279	11/23/2022	Yes	1300	1200	No	1.083333	Yes
280	11/23/2022	Yes	560	600	No	0.933333	Yes
281	11/23/2022	No	900	1100	Yes	0.818182	Yes
282	11/24/2022	Yes	1200	1100	No	1.090909	Yes
283	11/24/2022	Yes	900	850	No	1.058824	Yes
284	11/24/2022	No	1800	1700	No	1.058824	Yes
285	11/24/2011	Yes	750	1100	No	0.681818	No
286	11/24/2022	No	1200	1200	No	1	Yes
287	11/25/2022	Yes	1350	1100	No	1.227273	Yes
288	11/25/2022	Yes	1150	1200	No	0.958333	Yes
289	11/25/2022	No	1200	1300	No	0.923077	Yes
290	11/25/2022	Yes	900	800	No	1.125	Yes
291	11/26/2022	Yes	750	960	No	0.78125	No
292	11/26/2022	Yes	680	800	No	0.85	Yes
293	11/26/2022	No	780	1000	Yes	0.78	No
294	11/27/2022	Yes	500	700	No	0.714286	No
295	11/27/2022	Yes	1100	1500	No	0.733333	No
296	11/27/2022	Yes	1200	1400	No	0.857143	Yes
297	11/28/2022	No	950	1100	No	0.863636	Yes
298	11/28/2022	Yes	1200	1200	No	1	Yes
299	11/28/2022	Yes	1300	1400	No	0.928571	Yes
300	11/29/2022	No	1100	1150	No	0.956522	Yes
301	11/29/2022	Yes	500	750	No	0.666667	No
302	11/29/2022	Yes	800	900	No	0.888889	Yes

303	11/29/2022	No	1200	1200	No	1	Yes
304	11/30/2022	Yes	1050	1100	No	0.954545	Yes
305	11/30/2022	Yes	1100	1150	No	0.956522	Yes
306	11/30/2022	No	680	800	No	0.85	Yes
307	12/1/2022	Yes	0	500	Yes	0	No
308	12/1/2022	Yes	850	850	No	1	Yes
309	12/1/2022	Yes	1000	1200	No	0.833333	Yes
310	12/1/2022	No	1150	1200	No	0.958333	Yes
311	12/2/2022	No	855	900	No	0.95	Yes
312	12/2/2022	Yes	650	700	No	0.928571	Yes
313	12/2/2022	No	850	850	No	1	Yes
314	12/3/2022	Yes	1200	1200	No	1	Yes
315	12/3/2022	Yes	1150	1200	No	0.958333	Yes
316	12/4/2022	Yes	1100	1300	No	0.846154	Yes
317	12/4/2022	Yes	1200	1200	No	1	Yes
318	12/5/2022	Yes	1400	1500	No	0.933333	Yes
319	12/5/2022	Yes	1000	1200	No	0.833333	Yes
320	12/5/2022	Yes	650	800	No	0.8125	Yes
321	12/5/2022	Yes	800	800	No	1	Yes
322	12/5/2022	No	950	1100	No	0.863636	Yes
323	12/6/2022	Yes	950	1000	No	0.95	Yes
324	12/6/2022	Yes	1400	1600	No	0.875	Yes
325	12/6/2022	Yes	1650	1800	No	0.916667	Yes
326	12/7/2022	Yes	900	1950	No	0.461538	No
327	12/7/2022	No	450	1100	No	0.409091	No
328	12/7/2022	Yes	1000	1300	No	0.769231	No
329	12/8/2022	Yes	1500	1700	No	0.882353	Yes
330	12/8/2022	Yes	700	900	No	0.777778	No
331	12/9/2022	Yes	1100	1200	No	0.916667	Yes
332	12/9/2022	Yes	1100	1200	No	0.916667	Yes
333	12/10/2022	Yes	1000	1300	No	0.769231	No
334	12/11/2022	Yes	1400	1500	No	0.933333	Yes
335	12/12/2022	Yes	1400	1600	No	0.875	Yes
336	12/12/2022	Yes	950	1300	No	0.730769	No
337	12/12/2022	Yes	900	1700	No	0.529412	No
338	12/13/2022	Yes	1100	1500	No	0.733333	No
339	12/13/2022	No	200	900	Yes	0.222222	No
340	12/14/2022	Yes	900	1100	No	0.818182	Yes
341	12/14/2022	Yes	1300	1500	No	0.866667	Yes
342	12/15/2022	Yes	1500	1700	No	0.882353	Yes
343	12/15/2022	Yes	1450	1500	No	0.966667	Yes
344	12/15/2022	Yes	1100	1500	No	0.733333	No
345	12/16/2022	No	1550	1700	No	0.911765	Yes
346	12/16/2022	Yes	600	700	No	0.857143	Yes

347	12/16/2022	Yes	880	1000	No	0.88	Yes

Appendix F

Figure 1

Fishbone Diagram for Root Cause Analysis

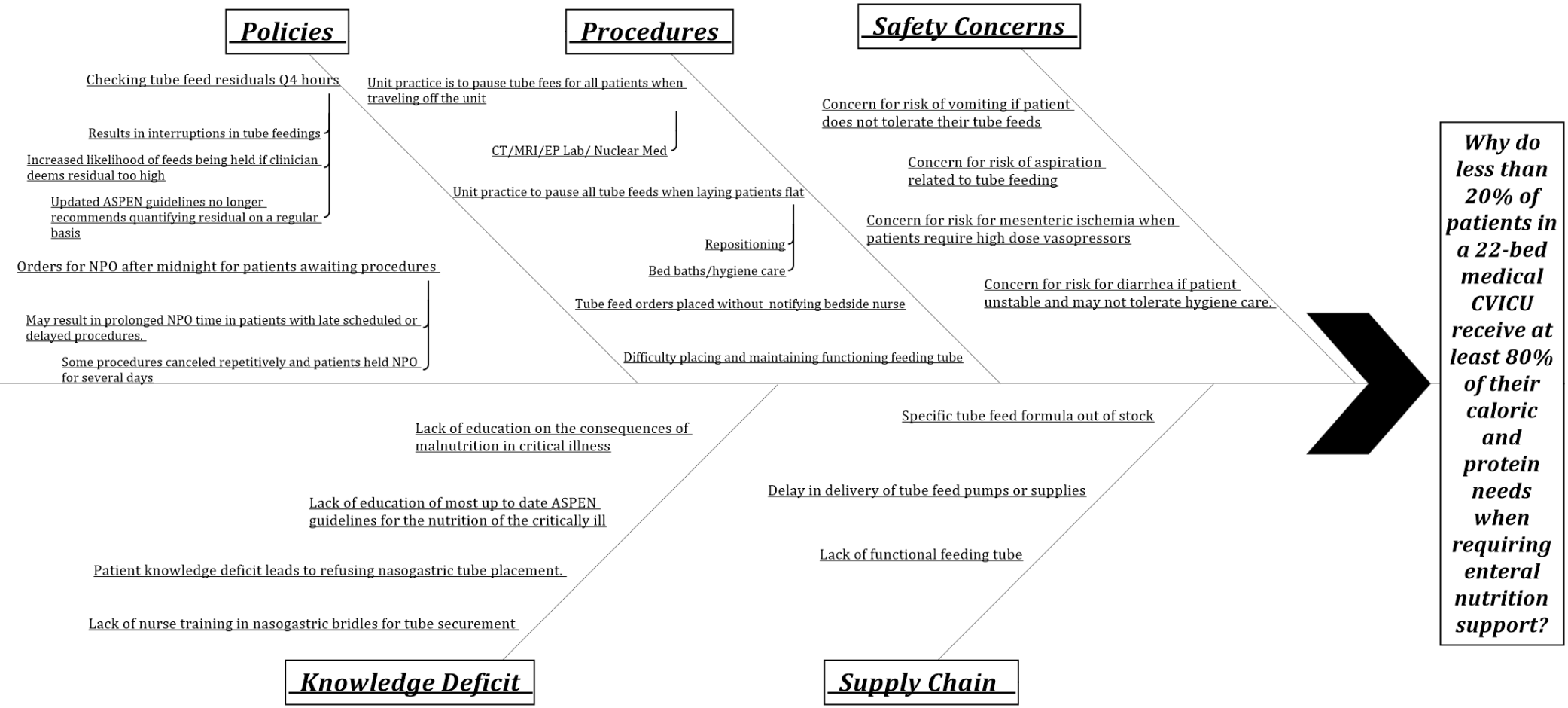


Figure 2

Current Process Map

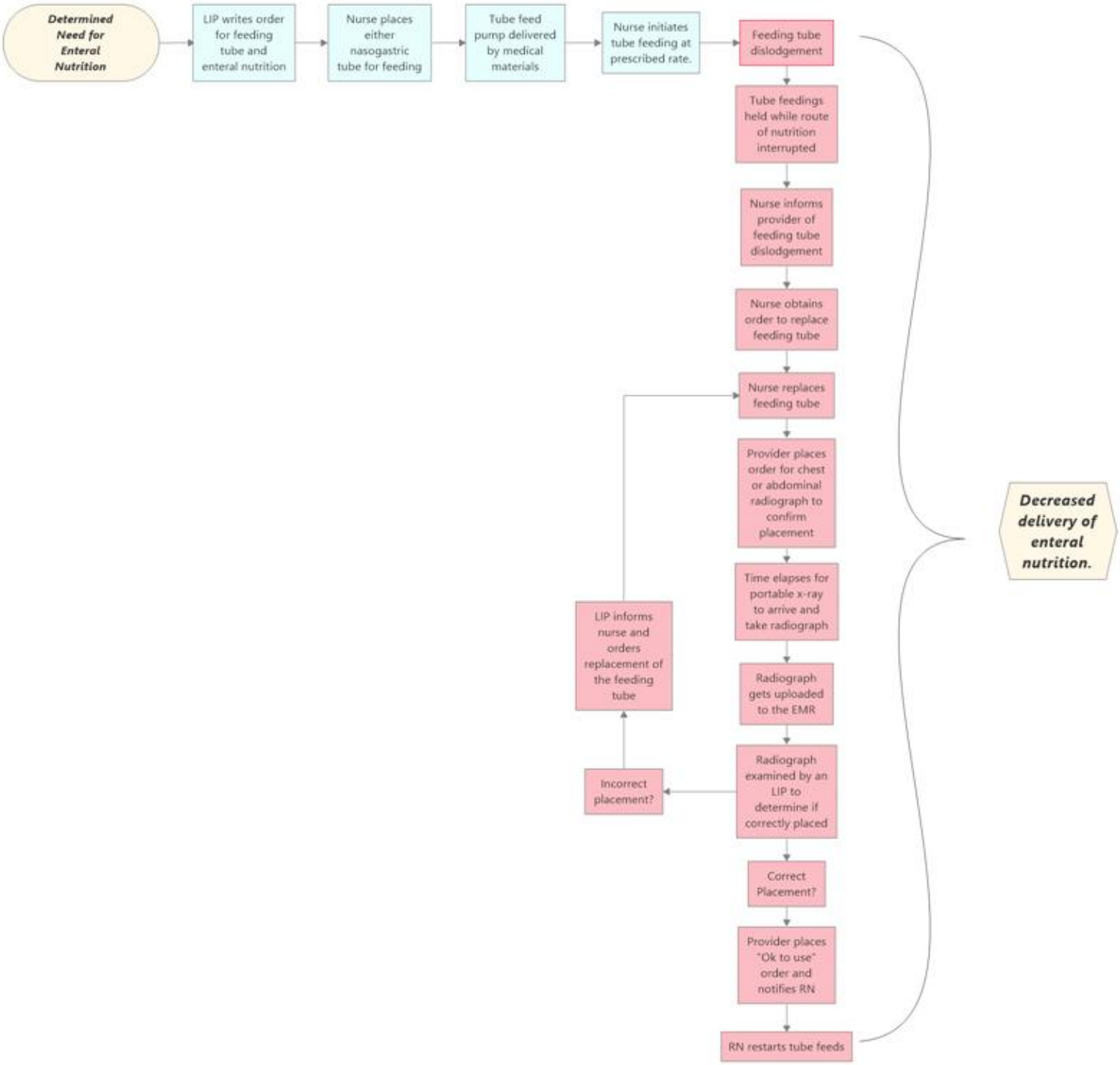


Figure 3

Desired Process Map

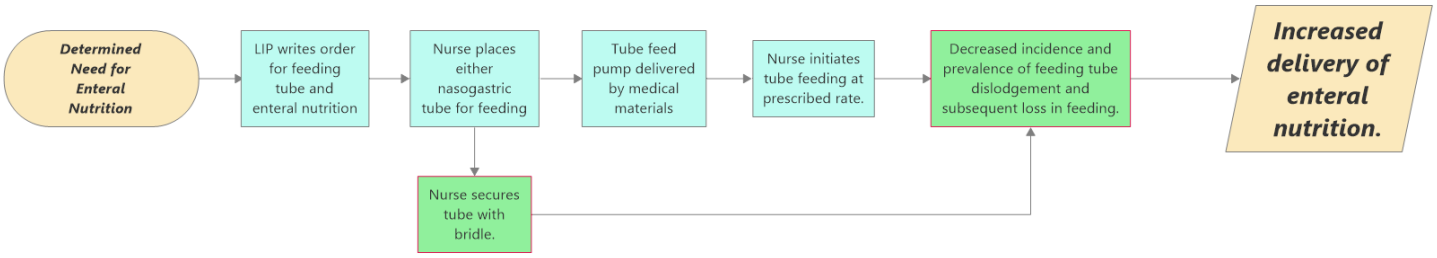
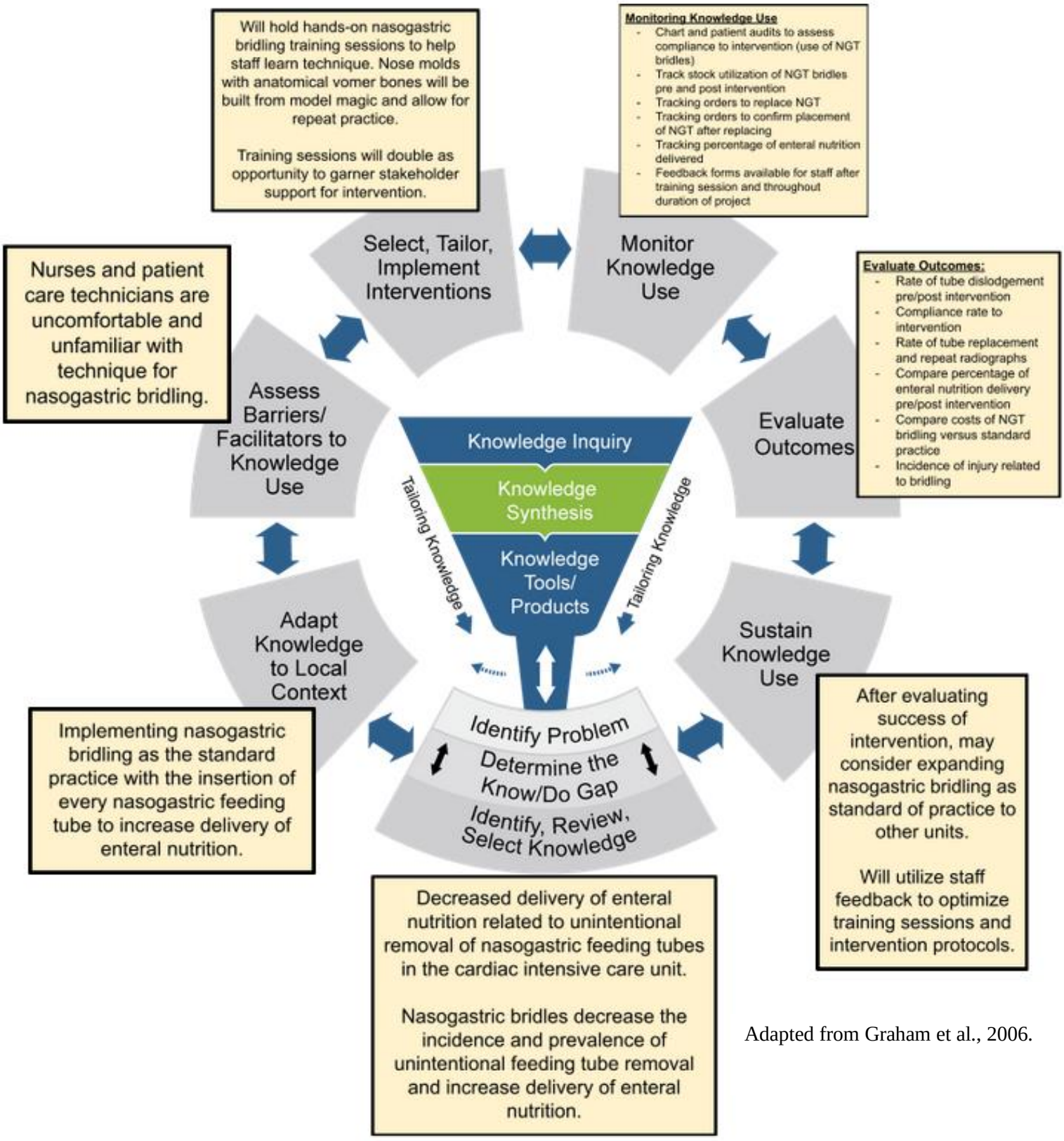


Figure 4

Application of the Knowledge to Action Framework



Adapted from Graham et al., 2006.

Figure 5

Nasal Bridle Utilization

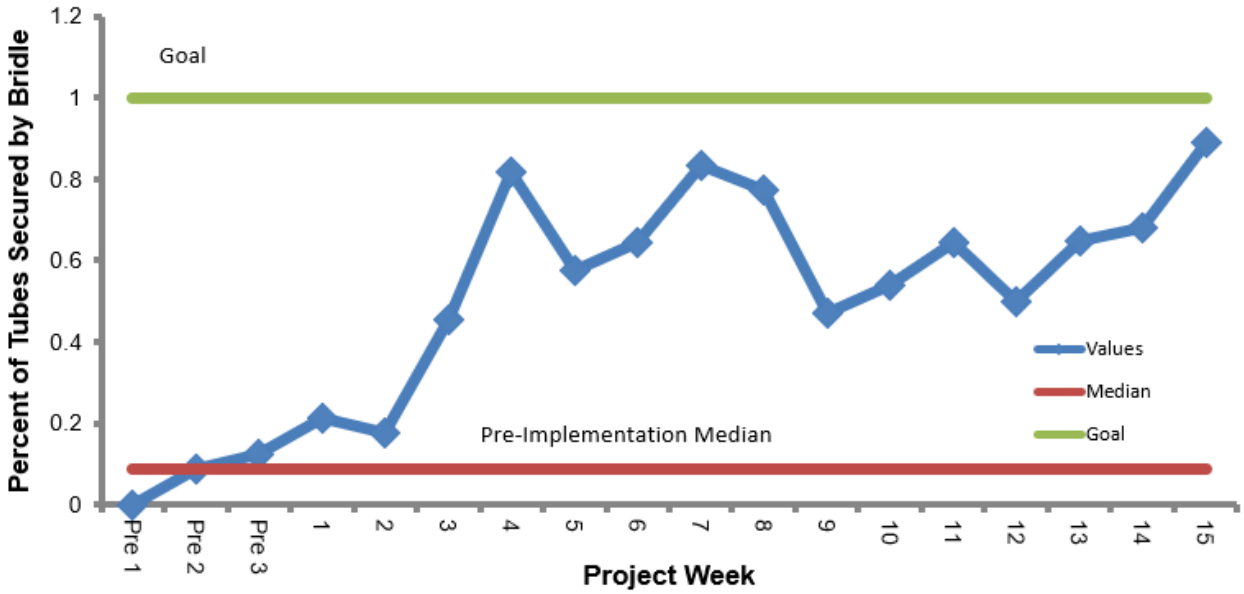


Figure 6

Rate of Nasoenteral Tube Dislodgement

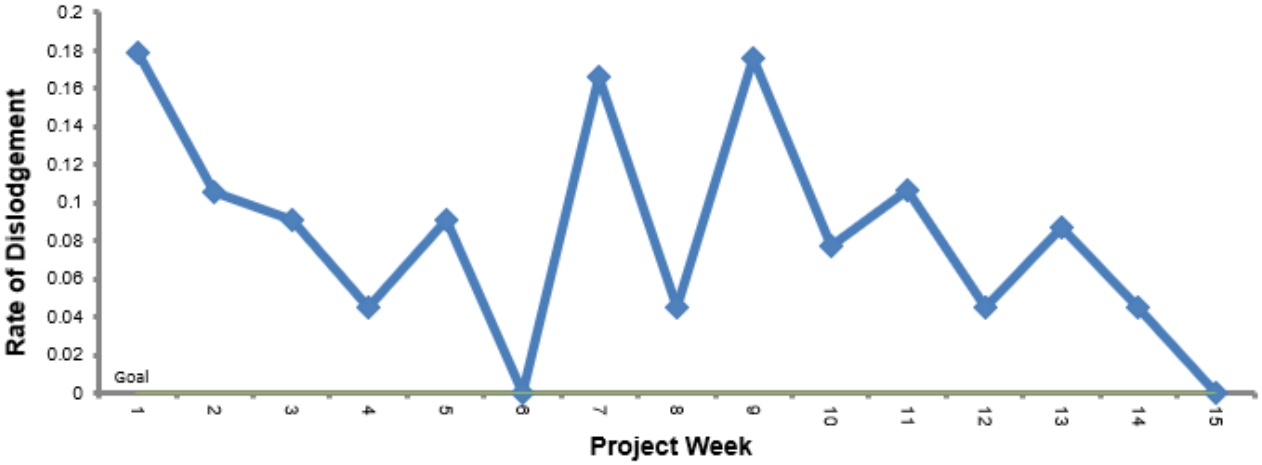


Figure 7

Percent of Enteral Nutrition Delivered

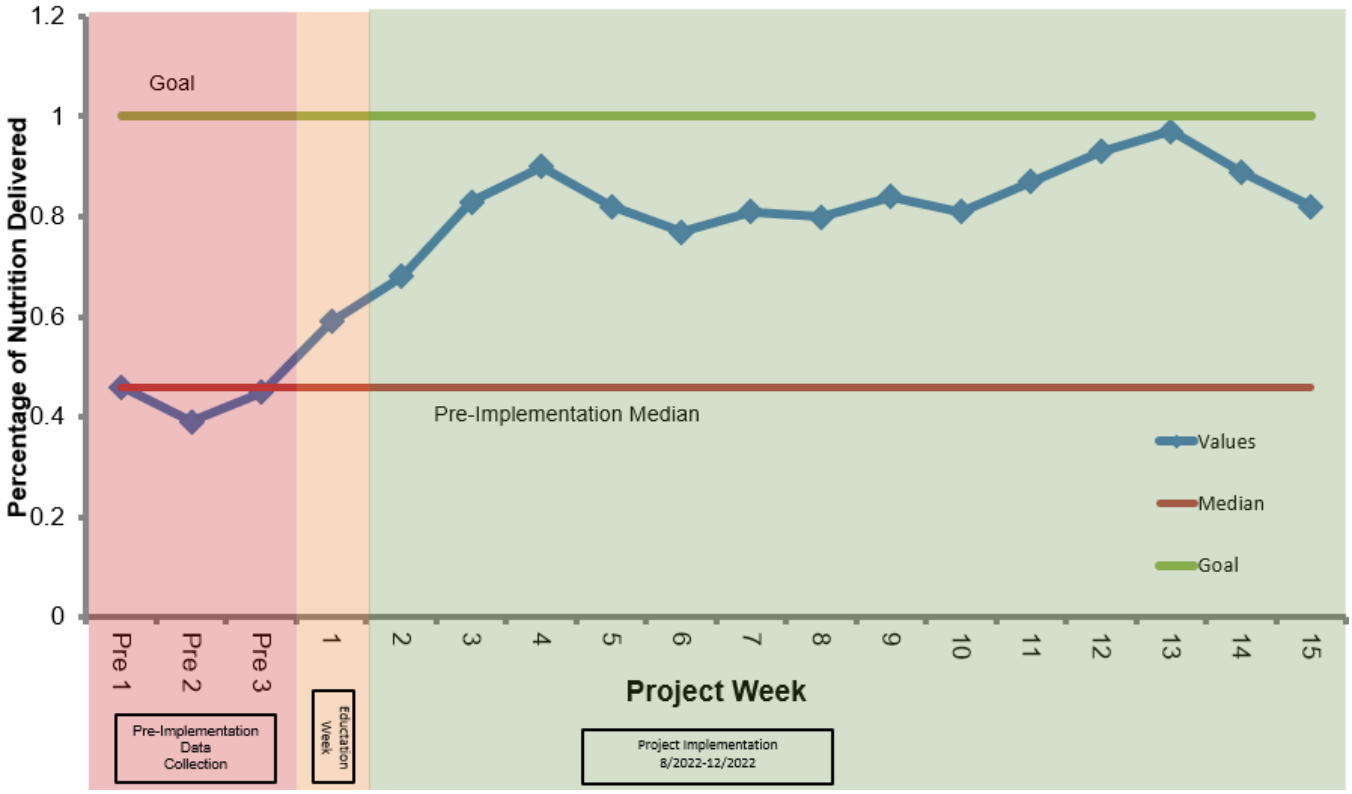


Figure 8

Scatterplots with the Regression Line Added for BridleStatus and Tube_Dislodged (left), BridleStatus and Percent_Delivered (right)

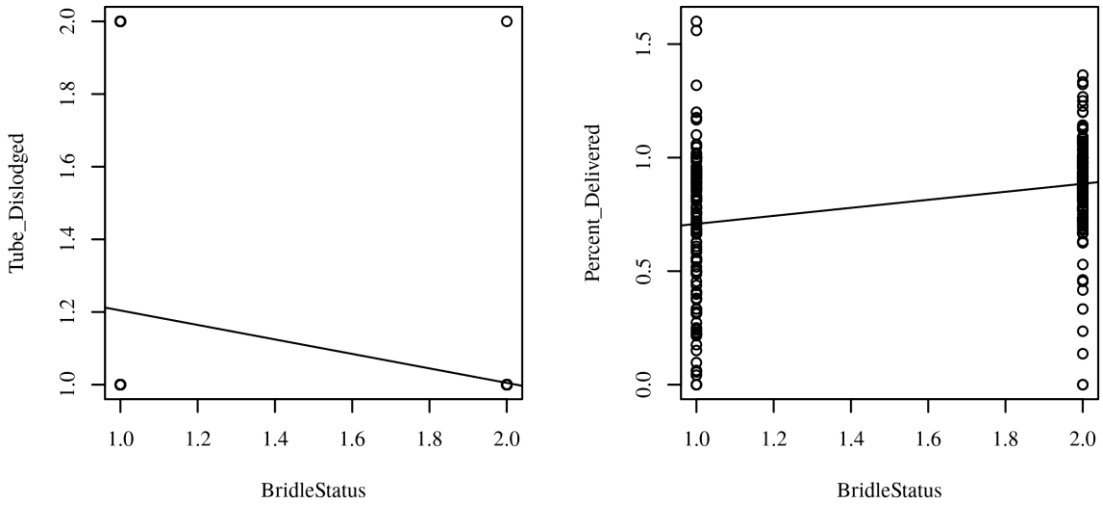


Figure 9

Scatterplots with the Regression Line added for Tube_Dislodged and Percent_Delivered

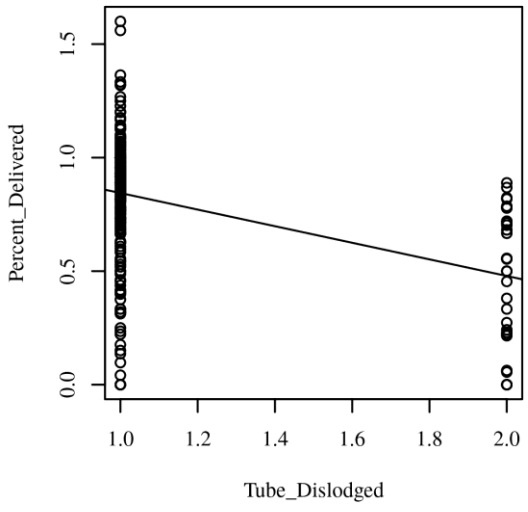


Figure 10

Q-Q Scatterplot for Normality of the Residuals for the Regression Model.